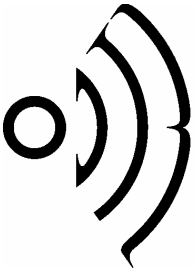

Office of the Director of
Telecommunications
Regulation

Annex B

DRAFT

CONDITIONS

for the Operation of Digital Programme Retransmission Systems

Document No. ODTR 98/35 **September 1998**

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CONTENTS

TECHNICAL CONDITIONS RELATING TO THE ESTABLISHMENT AND OPERATION OF DIGITAL PROGRAMME RETRANSMISSION SYSTEMS IN THE FREQUENCY BAND 2524-2668MHz

1 Purpose

This document specifies the general conditions attached to a licence for digital programme retransmission systems.

2 Summary Information.

These conditions detail the characteristics of the equipment that need to be considered for the purposes of frequency spectrum management, safety and the provision of a satisfactory service to the subscriber. and do not include detailed equipment specifications.

These conditions also detail those characteristics relevant for ensuring compatibility with other authorized users of the radio frequency spectrum.

The parameters specified in this document are mainly based on those given in ETSI and CENELEC documents: EN 300 749, TS 101 197-1 and EN 50221.

For issues not referred to by this document the licensee shall comply with standards set out in any relevant ETSI, IEC or CENELEC standard relating to DVB.

The Director of Telecommunications Regulation does not require evidence of type approval of equipment. Instead a procedure of system audits will apply.

The conditions specified in this document may be revised and/or added to from time to time.

Nothing contained in these conditions shall absolve the licensee from any requirement in law to obtain whatever additional consents, permissions, authorizations or licences that may be necessary for the exercise entitlements under the licence.

3 Definitions and Glossary of Terms

3.1 Digital MMDS System
A Digital Microwave Multipoint Distribution System is a fixed service system used for the retransmission of a modulated data stream containing Programme Service Multiplexes on a point to multipoint basis.

3.2 Headend
Equipment which is connected to receiving antennas or other signal sources and also connected to the remainder of the digital MMDS System, to process the signal to be relayed.

3.3 Effective Antenna Height (Eff. Ht.)
The height in metres above the average level of the ground between distances of 3 and 15 km from the transmitter. This is calculated for each of 36 evenly spaced radials (10 degree separation) starting from true North[1].
Note: This takes into account both the height of the site (a.s.l) and the height of the mast (a.g.l).

3.4 Omnidirectional Antenna.
An antenna having a horizontal radiation pattern with variations of 2 dB or less over 360 degrees.

3.5 Effective Radiated Power (e.r.p.) (in a given direction)
The product of the power supplied to the antenna and its gain in a given direction relative to a half-wave dipole. This is usually expressed in decibels relative to one watt (dBW).

3.5 Equivalent Isotropic Radiated Power (E.I.R.P.)
The Equivalent Isotropic Radiated Power is equal to the power supplied to the antenna multiplied by the isotropic gain of the antenna in a given direction.

3.6 Coverage Area
This is a geographical area within which the field strength is equal to or greater than the minimum field strength specified in section 11 of this document

3.7 ODTR
Office of the Director of Telecommunications.

3.8 Director
The Director of Telecommunications Regulation.

[1]This can be calculated by the ODTR using the national grid reference, consisting of one letter and six digits, for the transmitting station, provided the site height above sea level and the antenna height above ground level are supplied.

3.9 Subscriber feeder
A feeder connecting a Subscriber's antenna and downconvertor to a system outlet or, where the latter is not used, directly to the subscriber's equipment.

3.10 System Outlet
A device for connecting a subscriber's feeder to a receiver lead.

3.11 Subscriber's Equipment
Equipment at the subscriber's premises such as compatible Set Top Boxes, Integrated Receiving Devices, or any device that is, or contains a compatible decoder.

3.12 Carrier to Noise ratio
The difference in decibels between the carrier level at a given point in the system and the noise level at that point (measured within a bandwidth appropriate to the television or radio system in use).

3.13 'Must carry' programme services
These are television programme services which the licensee is obliged by the terms of his license to distribute on the Digital MMDS system.

3.14 'Basic service' programme services
These are television programme services relayed by the licensee which a person is obliged to pay for in order to become a subscriber to Digital MMDS system

3.15 Programme Services Multiplex
A signal containing more than one programme service, (which in its baseband form is a DVB transport stream, but is a NQAM signal with a bandwidth of 8MHz when modulated) with associated and other data.

3.16 Transport Stream
A data stream corresponding to the relevant ETSI (DVB) standards carrying MPEG2 encoded video and associated data.

3.17 European Standards Body
A Body such as ETSI IEC or CENELEC who specify standards for equipment or services.

Q3.1 Are these definitions appropriate and complete?

4. System Transparency

4.1 Television

Unless specifically excluded by the licence the Digital MMDS system shall be designed in such a manner that it is capable of relaying all components within a Programme Service, intended for general reception[2] [3].

Note:- This would include:-

TeleText and additional sound channels associated with the vision material. (see section 6.3.1)

5. System Engineering

5.1 General

The mechanical and electrical construction of the Digital MMDS system shall be in accordance with best practice.

- The practice of good system engineering is a necessary requirement to ensure the provision of a high quality service and the minimizing of the potential for interference to, or from, radiocommunication services operating in accordance with the Irish Table of Frequency Allocations

5.2 Headend Installation

As the performance of the headend installation is critical to the overall performance of a Digital MMDS system, care must be taken in the installation and maintenance of this equipment. The headend and associated equipment shall be labeled with the manufacturer's trade mark, type designation and function. The label shall be fitted on the outside of the equipment, and shall be clearly readable.
All controls, displays, meters, indicators and terminals shall be clearly labeled. Controls which, when wrongly adjusted, increase the risk of causing interference or of improper functioning of the system shall only be immediately accessible to qualified personnel only.

5.2.1 Spurious Emissions and Receiver Filtering

[2] While not intended for reception by the general public, the broadcast organisations include Test signals in the Transport Stream. The system must be transparent to these signals so as to facilitate performance measurements.

[3] While the Digital MMDS system shall be designed to relay all the components within a television signal the actual components relayed shall take account of the copyright arrangements between the licensee and the service provider.

Careful consideration should be given to the levels of unwanted emissions received at the headend and adequate filtering employed to ensure that the picture quality as specified in Section 7.1 for each system outlet can be met.

5.2.2 Headend Output

The signal parameters at the headend output should be such as to permit the Digital MMDS system to operate in accordance with the system standard and performance set out in Sections 6 and 7 respectively.

5.3 Weather Protection.

All apparatus and cables exposed to weather, corrosive atmosphere or other adverse conditions shall be so constructed or protected as may be necessary to prevent danger or interference arising from such exposure.

Q5.1 Are these provisions sufficient to ensure a satisfactory standard of service?

6. System Standards

6.1. Transmission Standard

The Transmission Standard used shall be the DVB-MC standard as specified in ETS 300 749

6.2 Summary List of Parameters

6.2.1. Frequency Spacing and Bands of Operation

Nominal radio-frequency channel bandwidth of a Programme Services Multiplex	8 MHz
Frequency Band	2524-2668MHz

6.2.3 Modulation

Type of modulation (N Quadrature Amplitude Modulation)	D7W
Number of states	16, 32, 64

6.2.4 Emission Designation

8M00D7WFT

6.2.5 Encoding Standards

Video	MPEG 2 Main Profile, Main Level, ISO/IEC 13818-1
Audio	MPEG 2 layer I and II, ISO/IEC 13818-1
Data	EN 301 192

6.2.6 Minimum Programme Bit rates

Encoded Video	4.5MBps
Encoded Audio, Stereo Channel	256kBps
Encoded Audio, Mono Channel	96kBps

6.3 Additional Broadcasting Services

6.3.1 Permitted Additional Broadcasting Services.

The transmission of a subtitling or teletext service is permitted. The system used must conform to ETS 300 743 or any future European standard describing the implementation of such services.

6.3.2 Additional Broadcasting Services Requiring Approval from the Director of Telecommunications Regulation

Prior approval must be obtained from the Director of Telecommunications Regulation for any additional services other than those indicated in Section 6.3.1 that are included within a Programme Service Multiplex.

Q6.1 Is the use of the DVB-MC standard appropriate?
Q6.2 Should a modulation type and emmission designation other than that specified in 6.2.3/6.2.4?
Q6.3 Are the encoding standards in 6.2.5 appropriate?
Q6.4 Are the minimum bit rates proposed in 6.2.6 sufficient?
Q6.5 What TeleText delivery methods might operators provide other than those suggested in 6.3.1?
Q6.6 What additional broadcasting services other than those suggested in 6.3.1 would you envisage?
Q6.7 What future developments do you envisage that will require revision of these conditions?

7 System Performance

7.1 Impairment Quality

The performance limits set out in this section apply in the presence of all signals for which the Digital MMDS system was designed.

There are two main forms of visible interference in a digital television signal. These are exhibited by artifacts such as an absence of picture, freezing of frames and blocking (where the picture turns into course blocks).

The signal should be free from all such interference for 99% of the time at all locations served.

7.2 Planning Field Strength

The maximum field strength of a digital signal at any point, in any adjacent cell, where the channel is in use for an analogue television signal shall be 46dBμV/m. This is based on an analogue signal suffering interference from the digital signal requiring a protection ratio (PR) of 40dB.

However, if a digital system is proposed where the protection ratio required by the analogue service from an interfering digital service is greater than 40dB, the maximum field strength shall be FS_{max}=(86-PR) dBμV/m.

7.3 Impedance

The nominal impedance of the system shall be 75 ohms. It should be noted that this value applies to all coaxial feeder cable and system outlets and shall be used as the reference impedance in level measurements on the Digital MMDS system

7.4 Measurement Point

The parameters specified in Section 7 relate to performance at the system outlet

7.5 Limit on Effective Antenna Height

The transmitting antenna shall be limited to that height necessary to provide a line of sight path to the required coverage area. Heights above 200 metres will not normally be allowed except as special cases.

7.6 Limit on Equivalent Isotropic Radiated Power

In general, the EIRP shall be adjusted so as not to cause the field strength, at the edge of the Primary Cell, as calculated by using figure 1, to exceed 46(dBμV/m). The maximum EIRP must not exceed 12dBW in any direction

7.7 Relaxation of EIRP and Effective Antenna Height Limits

If the desired field strength is not obtained at the edge of the coverage are, the Director may consider a request to increase the EIRP and or the Effective Antenna Height. The maximum EIRP must not exceed the limits set in 7.6 above at an Effective Antenna Height of 200m.

Where a case is made for an Effective Height above 200m the maximum permissible EIRP shall be reduced by 1dB for every 25m of height above 200m. The maximum reduction will be 5dB at the maximum permitted height of 325m.

Excessive EIRP or Effective Antenna Heights proposed merely to provide coverage to relatively few receiving stations which are not ideally located will not be permitted. Greater than maximum Effective Antenna Heights and EIRPs will only be permitted where they do not cause interference to other services in the same or adjacent bands.

7.8 Transmitting Antenna

The polar pattern of the transmitting antenna will be dependent on it's location relative to it's service area. The antenna shall employ linear polarisation, using the vertical or horizontal component in accordance with the national plan.
The orthogonal component shall be at least 22dB below the wanted signal.

7.9 Transmitter Characteristics

7.9.1 Frequency Range of Operation

The transmitter will operate within the following frequency band 2524-2668MHz

7.9.2 Frequency Stability

When a Programme Service Multiplex is locally generated, the variation in frequency from the declared nominal value shall not exceed $\pm$500Hz

It is recommended that if a number of channels are combined into a single antenna for transmission, a common frequency source is used for obtaining each channel.

7.9.3 Transmitter Spurious Emissions

Emissions appearing on frequencies outside of the allocated channel bandwidth shall be attenuated in the following manner. 50dB at the edges, falling to 60dB at 0.5 MHz beyond the band edges and then to 60dB thereafter.

If the transmitter site is shared with or is adjacent to that of another radio service, the Digital MMDS system operator may be required to take special measures to reduce the level of spurious emissions to below the stated level.

Q7.1 Is 99% time interference free appropriate?
Q7.2 Are the proposed Maximum Field Strengths and analog Protection Ratios in 7.2 appropriate?
Q7.3 What Protection Ratios and Maximum Field Strengths do you believ should be detailed?
Q7.4 Is the maximum EIRP proposed in 7.6 apropiate?
Q7.5 Is it appropriate that sites with an effective height of greater than 325m should be permitted provided that the EIRP is 20dB less than the analogue services at that site?
Q7.6 Should the transmitter stability in 7.9.2 be relaxed or tightened.
Q7.7 Are the proposed spurious emissions limits in 7.9.3 appropriate?

8. Receiver Characteristics

8.1 Receiver Antenna Characteristics

The receiving antenna shall normally have the following minimum characteristics

Antenna gain	22dBi
Antenna front to back ratio	20dB
Orthogonal polarisation discrimination	19dB Main Beam 6dB All other Azimuths

8.2 Down Convertor Characteristics

Noise Figure	2dB
Output Impedance	75 Ω
Output level	50dBμV (+12dB, -6dB)

Output Frequency Range

Band III	174-230MHz
Band IV/V	470-790MHz

The receiving equipment interconnections shall use high quality double-screened co-axial cable of the tape and braid variety.

8.2 UHF/VHF By-pass Facility

Facilities must be provided within the MMDS receiving system to enable the system to be 'by-passed' and off air signals to be received.

8.3 Spurious Emissions

In any digital MMDS receiving device the output power of any spurious emissions shall not exceed 2nW in the frequency range 100kHz to 1GHz and 20nW on all frequencies above 1 GHz.

Q8.1 Are the down-converters characteristics appropriate?
Q8.2 Is Section 8.2 required?

9. SAFETY

9.1 General Safety.

The station and it's premises must comply with all relevant statutory safety regulations.

9.2 Safety Controls

There shall be a single control to isolate power for the entire installation. If a form of auxiliary power (such as; diesel generators or an Un-interuptable Power Supply) is provided, then the same control should isolate these. The 'on' position of such a device must be clearly indicated. Guards may be fitted to the device to prevent accidental operation.

9.3 Safety Standards

The system must comply with the following requirements:

I.S./EN 60215 : 1990
Safety Requirements for Radio Transmitting Equipment.

ENV50166-2
Human exposure to electromagnetic fields
High frequency (10 kHz to 300GHz)

These standards are available from the National Standards Authority of Ireland[4].

Q9.1 Are there any other appropriate safety requirements and standards?

[4]Please note that the standard ENV 50166-2 is a European Pre standard and shall be replaced by the respective European Standard when it becomes available.

10 National Plan

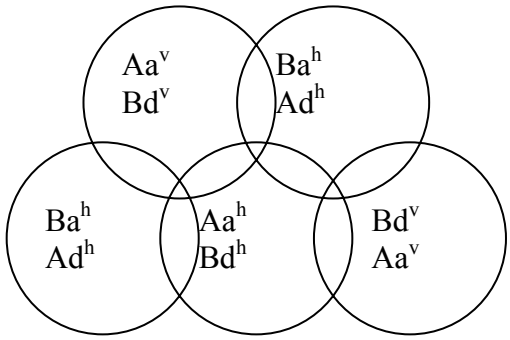
10.1 Channeling Groups

The proposed channeling arrangements are detailed in table 1. This consists of 18 channels in the band 2524-2668MHz, subdivided into 2 separate groups of interleaved channels. Group A use the odd numbered channels and group B the even channels. Different frequencies to those specified in table 1 will not normally be permitted.

Spectrum allocations may be revised in accordances with good frequency management and may be changed as a result of such reviews.

Each group of channels may be used with either a vertically or horizontally polarised antenna.

Where a cell uses the even channels for the analogue service then the odd channels will be used for the digital service see *figure1* below



Key:
Aa^x: Odd Channels Analogue (A Channels)
Ad^x: Odd Channels Digital
Ba^x : Even Channels Analogue (B Channels)
Bd^x : Even Channels Digital
x=v: Vertical Polarisation
x=h: Horizontal Polarisation

Notes: To prevent interference in the overlapping area between cells only one licensee may provide service in any given area. Licensees must come to an agreement between theirselves to provide service in overlapping areas

figure 1

10.2 Primary Tier of National Plan

Map1 and table 2 details the primary tier of the national plan. This is based on the strategy shown above. The plan is based on Primary Cells with radii of between 16 and 48 km. Terrain features have been used as far as possible to form the outer limits of the cells (see table 2 and map 1 for details.)

10.3 Modifications to the Plan

While the plan is based on transmitter stations using omnidirectional or near omnidirectional antennae sited at the centre of the Primary Cells (see grid references given in table 2). Applicants may, if they wish, use a different site using a suitable radiation pattern to provide the desired service.

The new EIRP should be determined bearing in mind the planning limit in section 7.

10.4 Fill-in Stations

Due to the limitations imposed on the signal by the surrounding terrain it may not be possible to service the entire cell from one area. In such cases fill in stations may be permitted. The proposed location and channel/polarisation combination should be submitted to the Director for consideration.

11 Coverage Area Prediction

The planning limit is 46dBμV/m and should not extend beyond the line of sight distance to the horizon or beyond the edge of the primary cell.

As this is a line of sight system, the propagation path between the transmitting and receiving antennae should be unobstructed.

The line of sight distance (D) in kilometres may be calculated from the following formula:

$$D=\sqrt{(12.6H)}$$

Where H is Effective Height in metres.

The EIRP and Effective Height should be selected, such that the field strength at the most distant location does not exceed the planning limit given in section 7.

12 Protection and Co-ordination

12.1 Protection Criteria

The channels used shall be in accordance with those indicated in tables 1 and 2. However additional channel requirements, for fill-in stations, shall satisfy the technical criteria for protection to all other planned/assigned channels. The protection contour shall be the limit given in section 7.

Unless advised to the contrary by the Director, it should be assumed that in the case of fill-in stations the protection contour shall not extend beyond the edge of the Primary Cells.

Assuming a

Carrier to Noise Ratio for 64QAM	**25dB**
Digital interfering with digital (co-channel) Protection Ratio	25dB
Digital interfering with digital (adjacent channel) PR	0dB
Analogue interfering with digital (co-channel) PR	5dB

The permissible interfering field strength at the protected contour is calculated according to the equation in section 12.2. For distances of 20 km or greater *figure 4* can be used. For distances of less than 20 km use *figure 3*. Special consideration should be given to areas of very irregular terrain.

Where a fill-in station is within the protection contour of another station the orthogonal polarisation shall be used.

12.2 Analysis of Protection Requirements

Protection analysis may be undertaken using the method shown below.

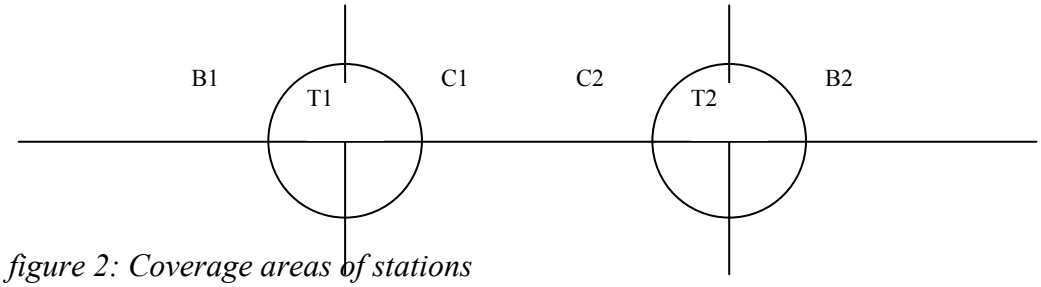


figure 2: Coverage areas of stations

Figure 2 shows the coverage areas of a protected station T1 and proposed station T2 which do not overlap. Overlapping service areas may be similarly analysed.

For co-channel and first adjacent channel stations, the maximum permissible interfering field strength at the protected contour of another station shall be determined using the following equation:

Fu = 46+GD+XPD-PR

Where: Fu Unwanted Interfering Field Strength

GD Receive Antenna Discrimination (20dB, locations C1 and C2; 0dB locations B1 and B2)

XPD Orthogonal Polarisation discrimination (when T1,2 use orthogonal polarisation).(19dB, locations B1 and B2; 6dB locations C1 and C2)

PR Protection Ratio.

The distance corresponding to Fu is determined from the curves shown in *figure 4* using the corresponding transmitting antenna height above the average terrain for each relevant direction. For distances less than 20 km use *figure 3*.

12.3 Co-ordination

Channel assignments in Ireland that are within approximately 80 km of the territorial boundary with Northern Ireland or within approximately 30 km of the east coast of Ireland may require co-ordination with the United Kingdom

administration. Such co-ordination will be undertaken by the Director in order to minimise the potential for interference between radio services in Ireland and those in the United Kingdom.

In considering sharing between the Digital MMDS system and other services in the same or adjacent bands, reference will be made to the standard ITU-R sharing criteria as specified in the Radio Regulations or any relevant ETSI standard.

Q12.1 Is a 64 QAM Carrier to Noise ratio of 25dB sufficient?

Q12.2 Should other modulation schemes (16QAM) be considered? What would be required? What protection ratios will be required?

Q12.3 What benefits are to be gained from and what difficulties do you believe will arise due to the nearby 2.4-2.5 GHz ISM band?

13 Access to Equipment, System Testing and Maintenance

13.1 Access and Personnel

The licensee shall on request made by an authorized officer of the Director of Telecommunications Regulation, facilitate that officer in the inspection[5] of any part of the Digital MMDS system.

13.2 Test Equipment (system performance)

Adequate test equipment shall be held by the licensee for measurements of the system performance parameters specified in Section 7 whilst the system is undergoing initial alignment, regular maintenance and performance audits.

13.4 Maintenance

The licensee shall ensure that the system is audited and maintained on a regular basis so as to ensure compliance with these conditions. The licensee shall keep a log indicating the dates and results of these audits and maintenance work undertaken. A copy of the maintenance programme and the log shall be made available to an authorized officer of the Director of Telecommunications Regulation on request.

Q13.1 Are these requirements appropriate, if not what alternative proposals do operators have?

14. Measurement Procedures.

14.1 Measurement of Performance Parameters

Unless otherwise specified by the Director of Telecommunications Regulation, the procedure for measuring performance parameters shall be in accordance with those specified in any relevant ETSI, IEC or CENELEC standard.

Note:- As some of these procedure involve the removal of the programme signal and replacing it by a test signal, for the duration of the measurement period, alternative measurement procedures may be considered by the Director so as to minimize disruption to the viewers. However where the Director is not satisfied with results obtained using alternative measurement procedures then the measurements shall be repeated using the procedures any relevant ETSI, IEC or CENELEC standard.

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15. Performance Audits and Information to be Submitted to the Director of Telecommunications Regulation.

15.1 Regular Performance Audits

[5] Inspection shall include the undertaking of measurements

Licensees will be required to undertake regular performance audits on their Digital MMDS system and submit the results to the Director of Telecommunications Regulation for consideration. These audits must be carried out in compliance with any methodology, time periods or requirements specified by the Director of Telecommunications Regulation.

15.2 Updating of Information on Subscribers

The licensee shall submit to the Director of Telecommunications Regulation on a six monthly basis an up to date list of:

- the number of subscribers using the Digital MMDS system

15.3 Update of System Information

The licensee shall upon request from the Director of Telecommunications Regulation, submit:-

an up to date frequency plan indicating the programme name of each television channel and its position and ID in the Programme Service Multiplex. The licensee shall notify the Director immediately any change occurs.

an updated network diagram/map of their system clearly indicating the most up to date geographical area of operation of their Digital MMDS system and the location of the headend.